Measurements of phosphate affinity constants and phosphorus release rates from the microbial food web in Villefranche Bay, northwestern Mediterranean

Tanaka, Tsuneo, Fereidoun Rassoulzadegan, T. Frede Thingstad

Limnol. Oceanogr., 48(3), 2003, 1150-1160 | DOI: 10.4319/lo.2003.48.3.1150

ABSTRACT: Using ^{32}>P, uptake and transfer of phosphorus in the microbial food web were studied in surface water from Villefranche Bay (northwestern Mediterranean) from September to December 2001. During the study, the thermocline gradually declined and vertical mixing started, leading to a transition from a nutrient-depleted period to a nutrient-replete period. Before vertical mixing started, the orthophosphate turnover time ranged from 1 to 5 h. Orthophosphate uptake was dominated by the 0.6-2 μm size fraction (mean, 70%), where the cyanobacteria biomass was dominant. The estimated affinity constants for bacteria, cyanobacteria, and autotrophic nanoflagellates ranged from 0.001 to 0.028, 0.047 to 0.103, and 0.002 to 0.032 L nmol P^{-1} h^{-1} during the period, with relatively short (< 5 h) orthophosphate turnover times. These results suggest that cyanobacteria were superior for orthophosphate uptake among osmotrophs. For cyanobacteria and autotrophic nanoflagellates, the mean affinity constants were almost at the theoretical maximum predicted by diffusion-limited uptake. On the basis of a cold-chase technique, release rates of dissolved ^{32}P from labeled particles were < 0.5% h^{-1}, which corresponds to a turnover time of the particulate fraction up to three orders of magnitude greater than that of orthophosphate. Although a net loss of ^{32}P occurred in the 0.2-0.6 and 0.6-2 μm fractions, a net increase in the >2 μm fraction suggested P transfer to the larger size fraction by predation. Viruses did not contribute significantly to ^{32}P release from bacteria during the study period.